

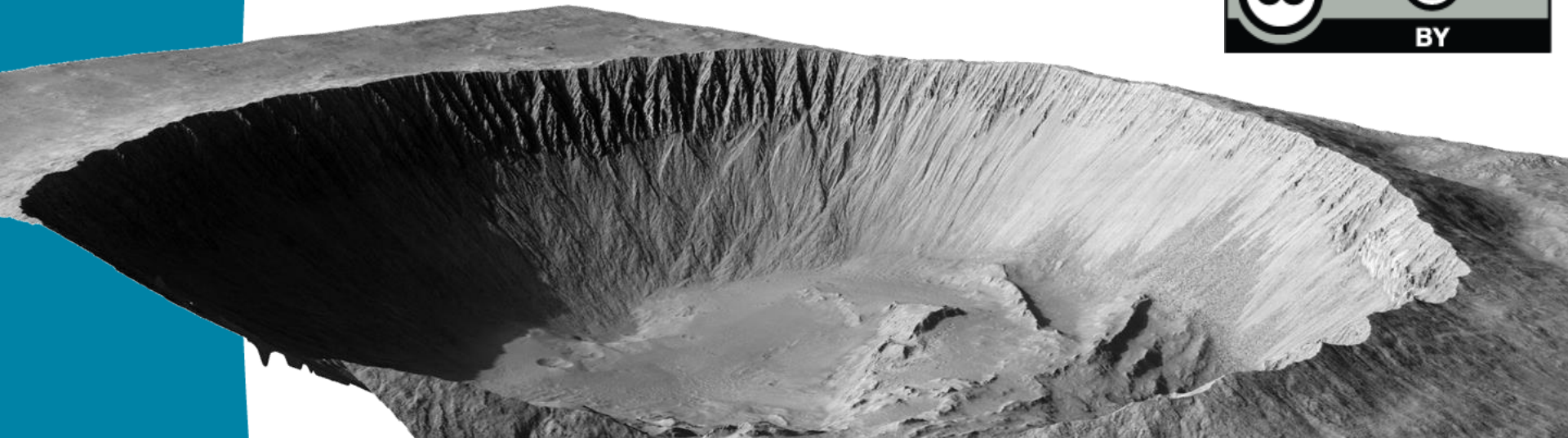


Universiteit Utrecht  
Faculty of *Geosciences*

*Martian*

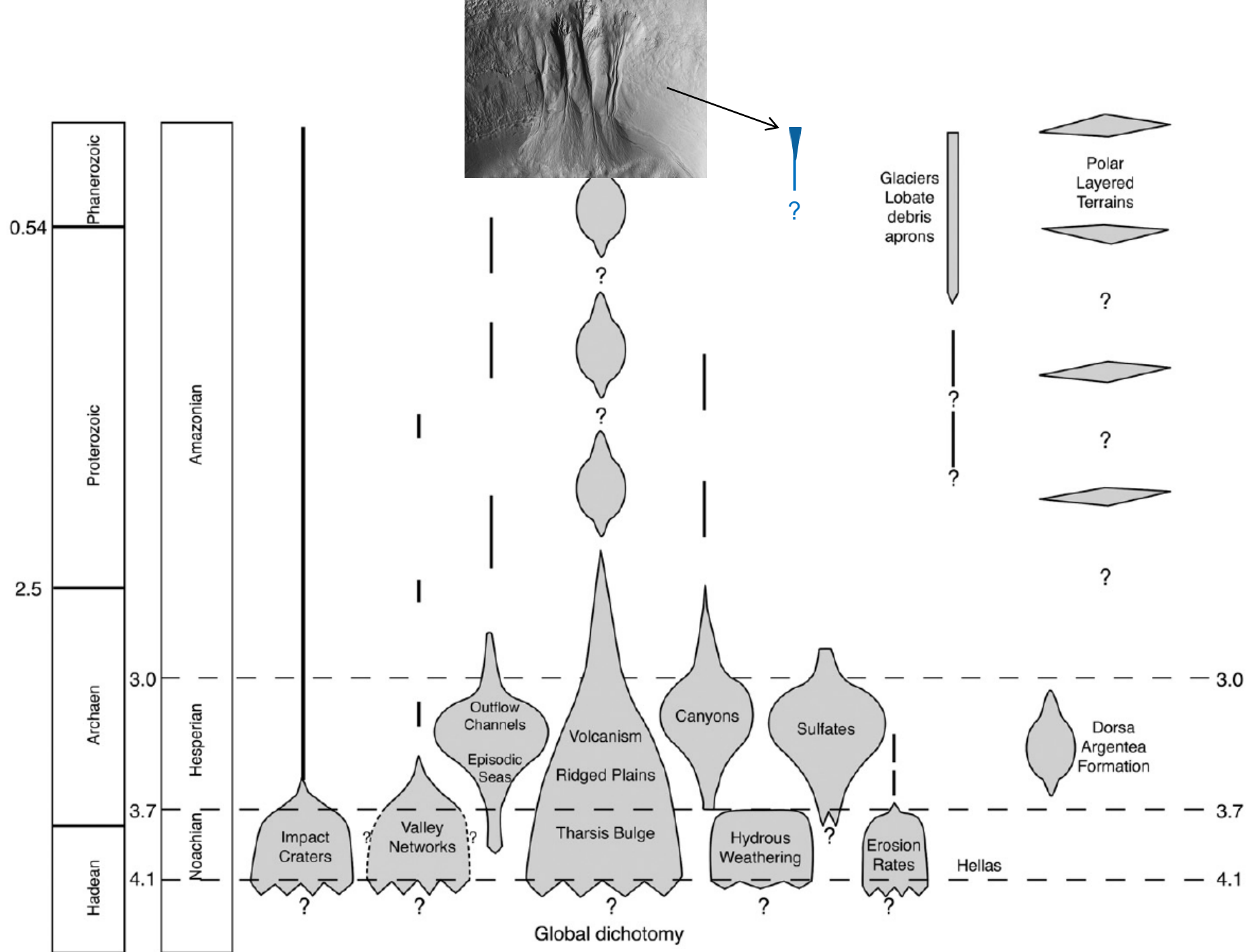
Research group  
**River and delta morphodynamics**

# Earth-like debris-flow activity on Mars



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Susan J. Conway, Ernst Hauber, Andreas Johnsson, Maarten Kleinhans





How much liquid water was there?

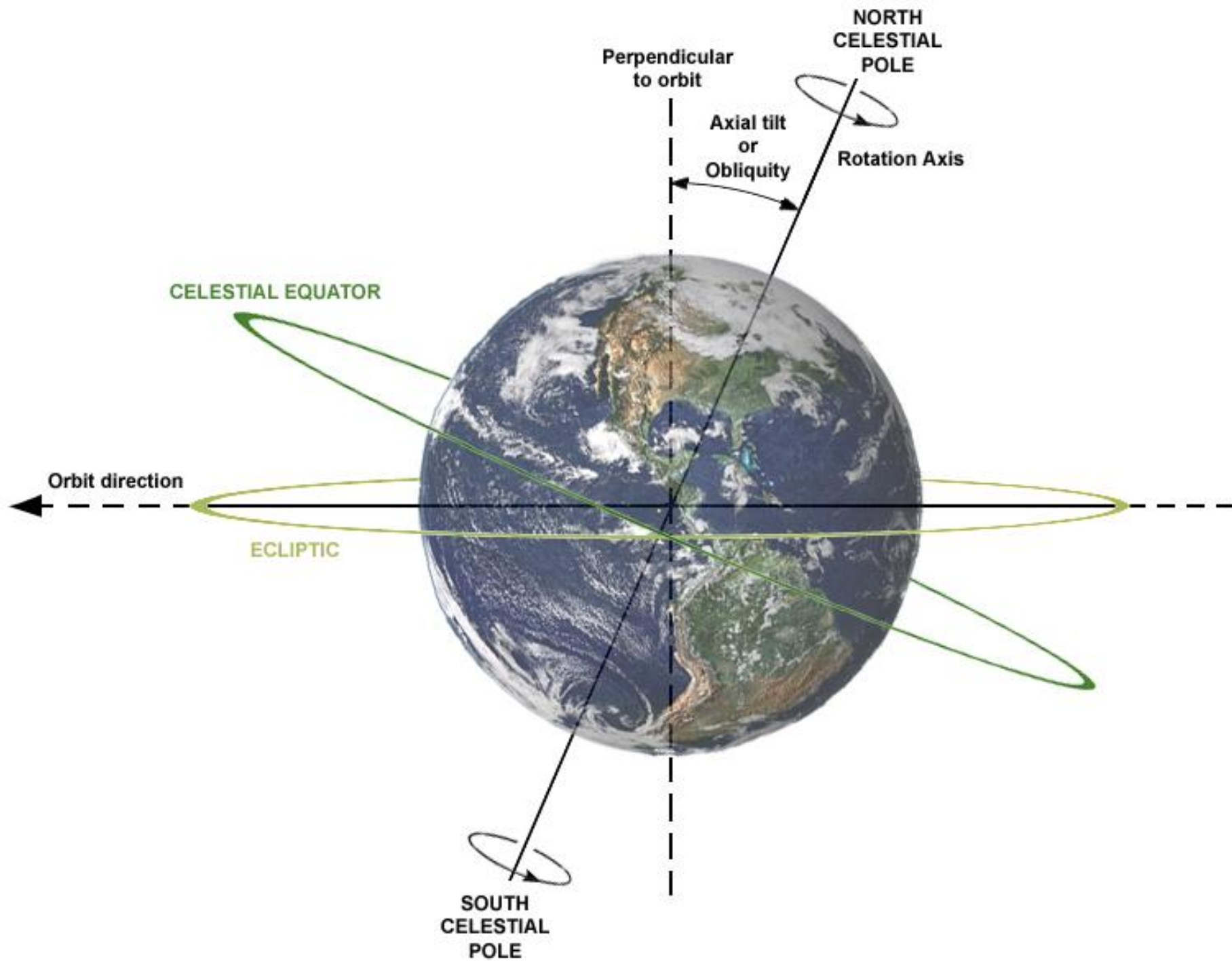
How often fluvial activity?

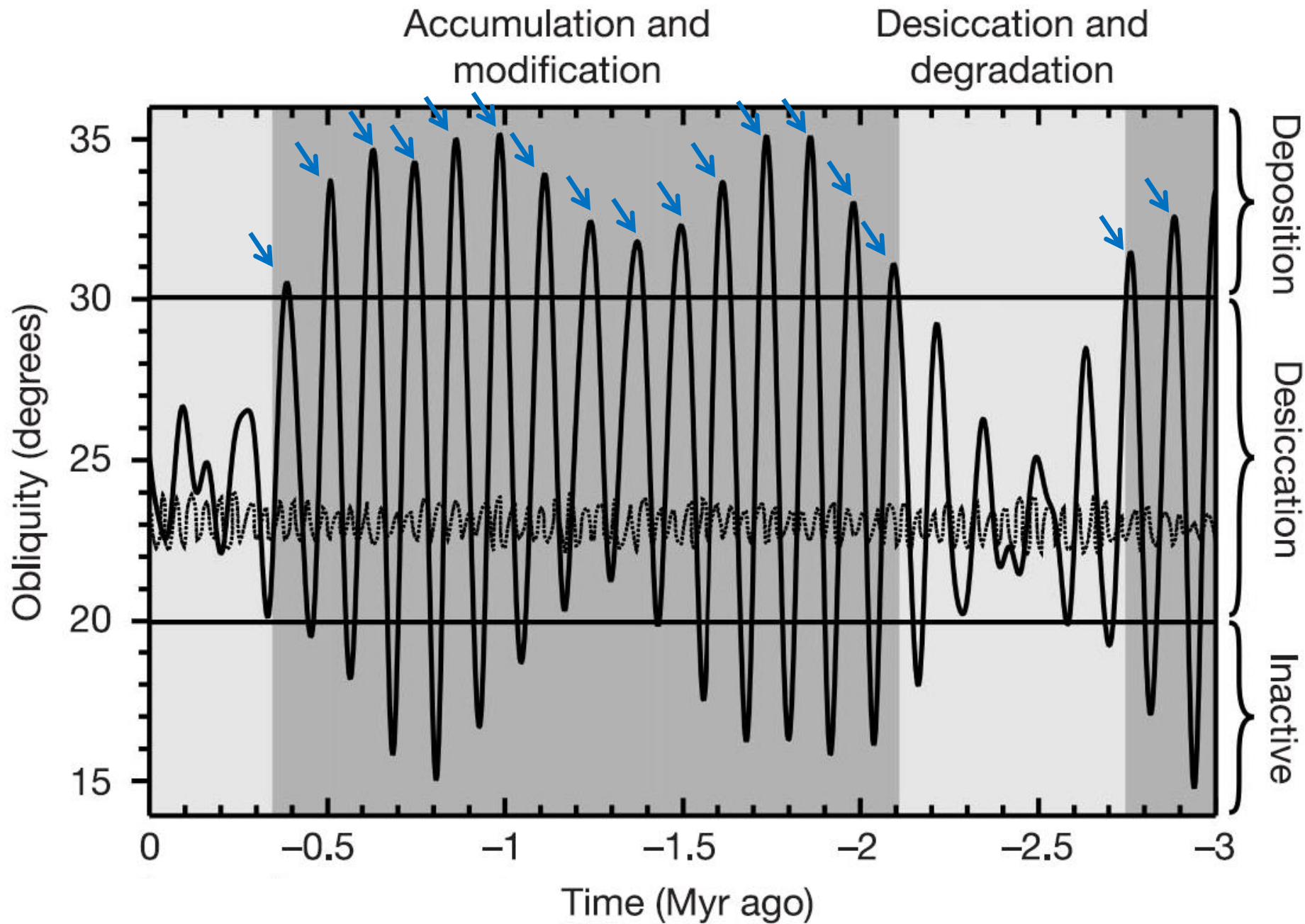
How much snowfall needed?

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500 m



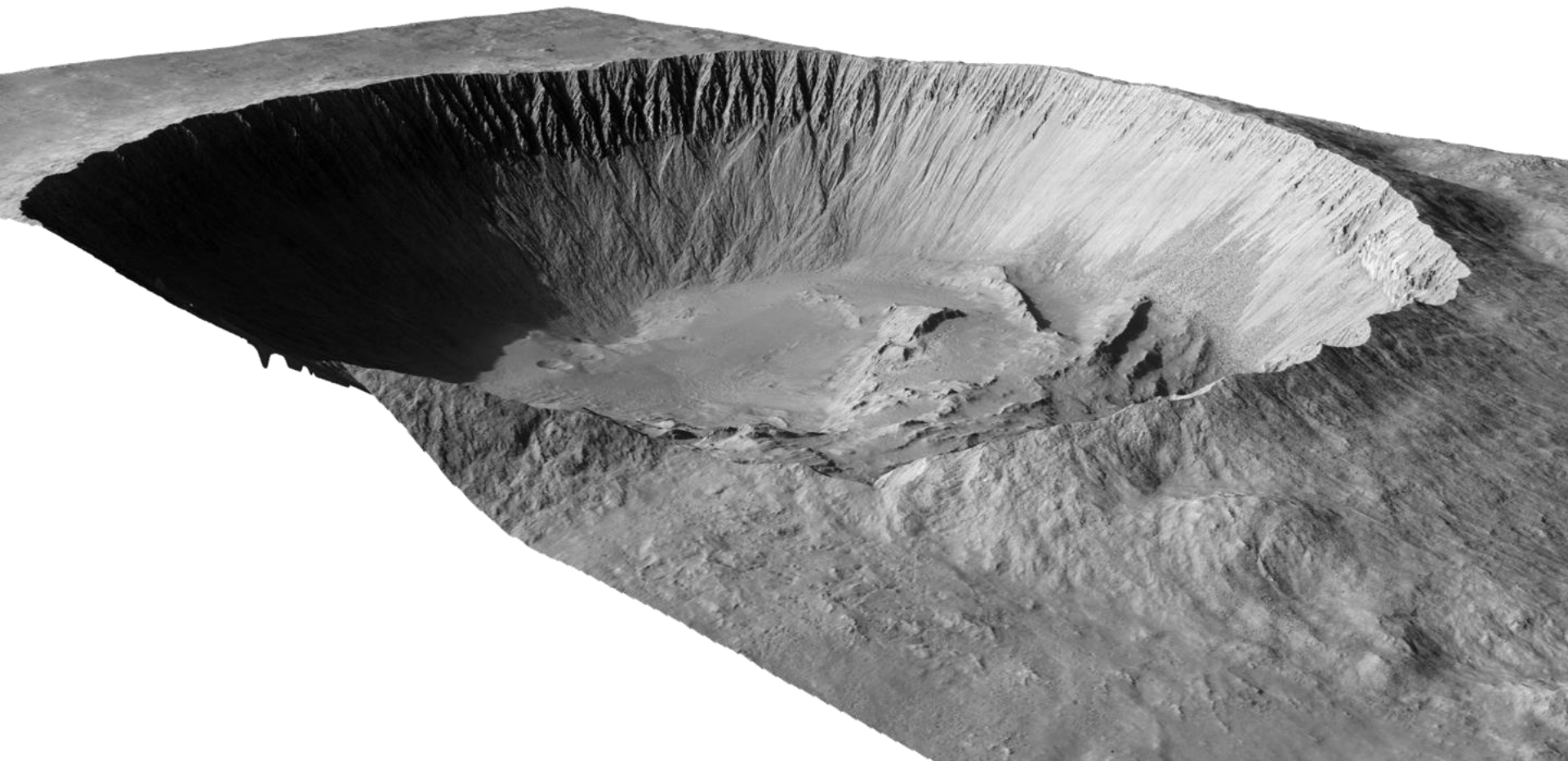


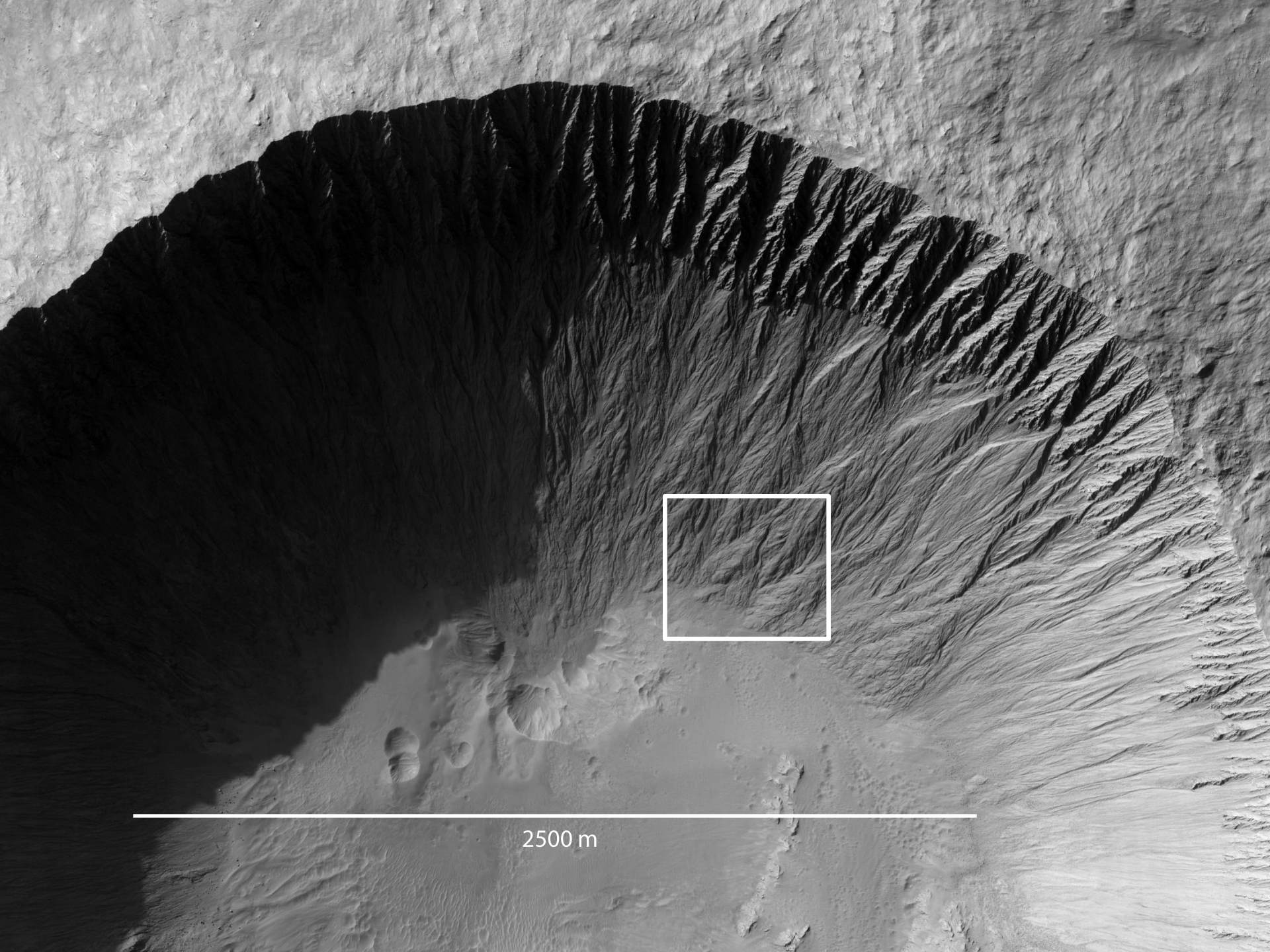






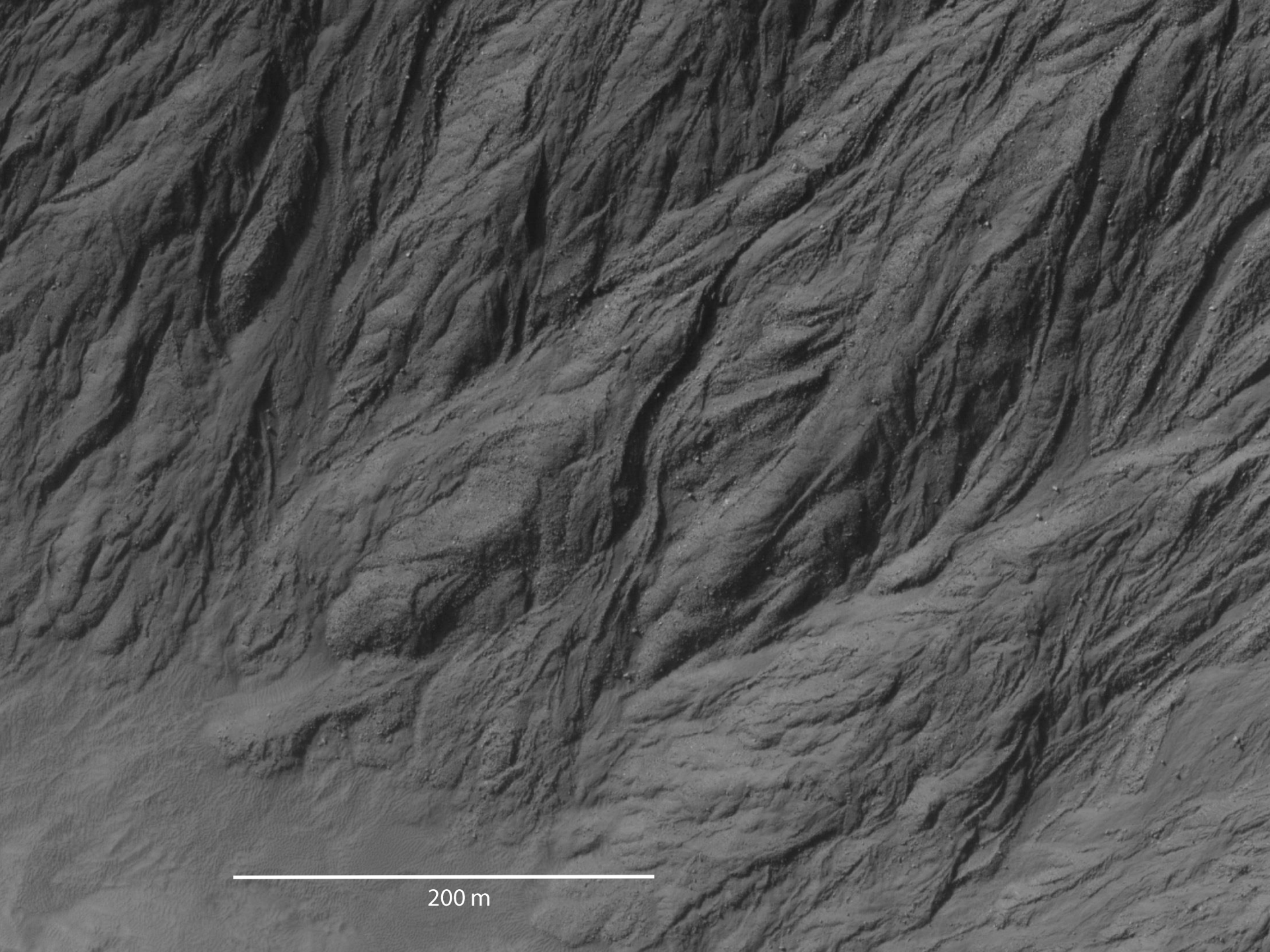
# Istok crater





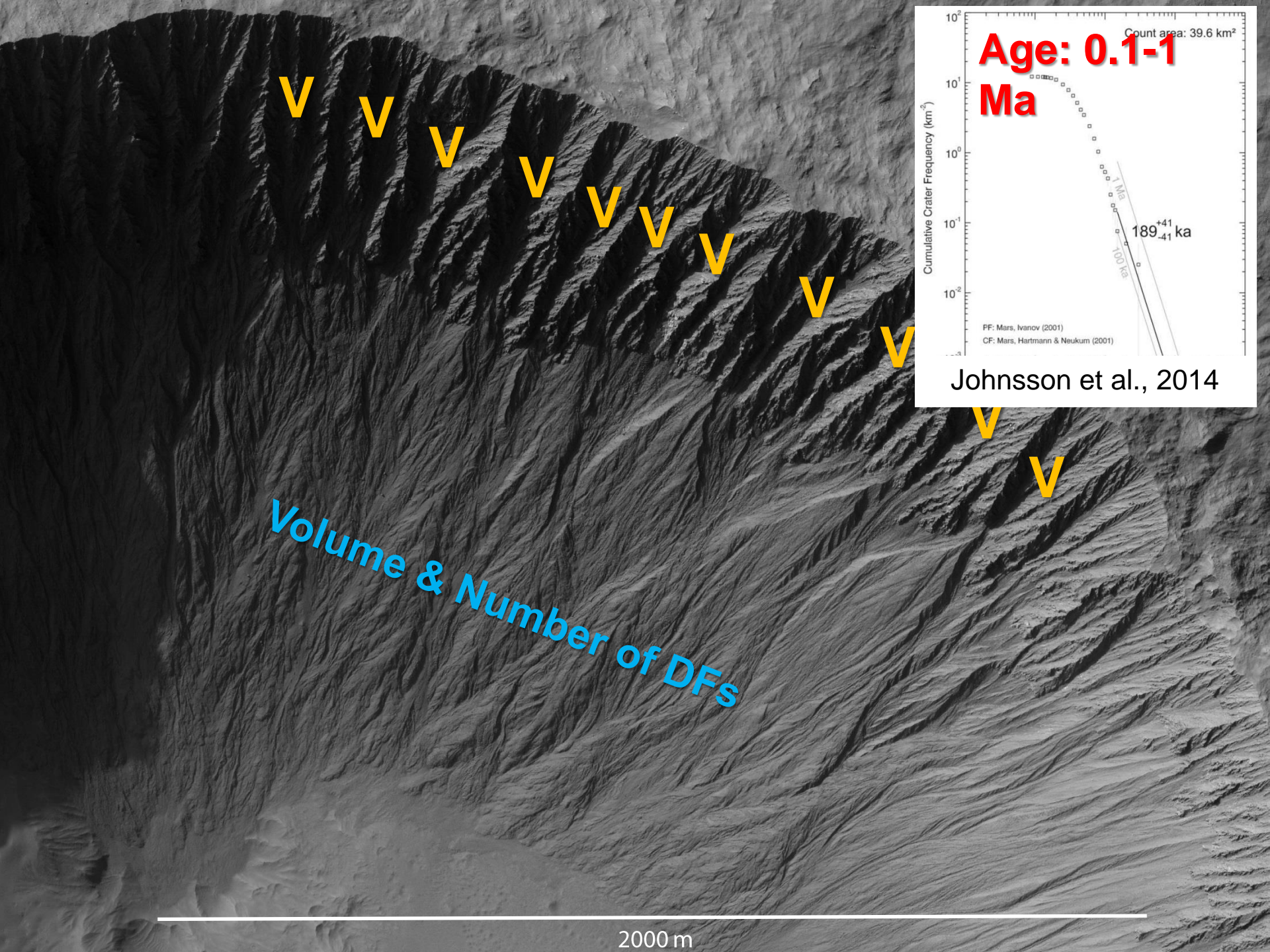
2500 m





200 m





V

V

V

V

V

V

V

V

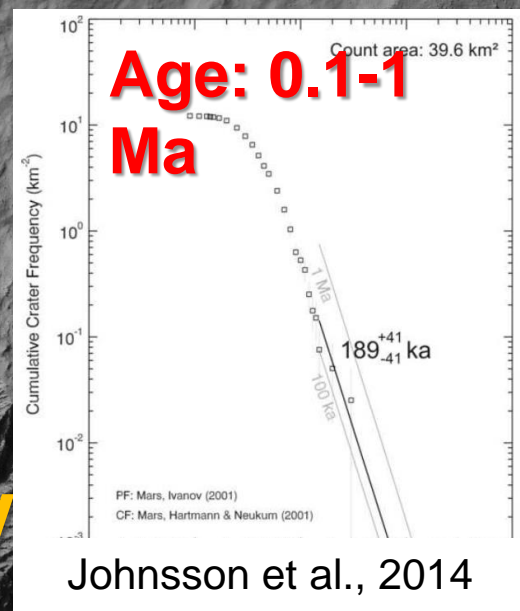
V

V

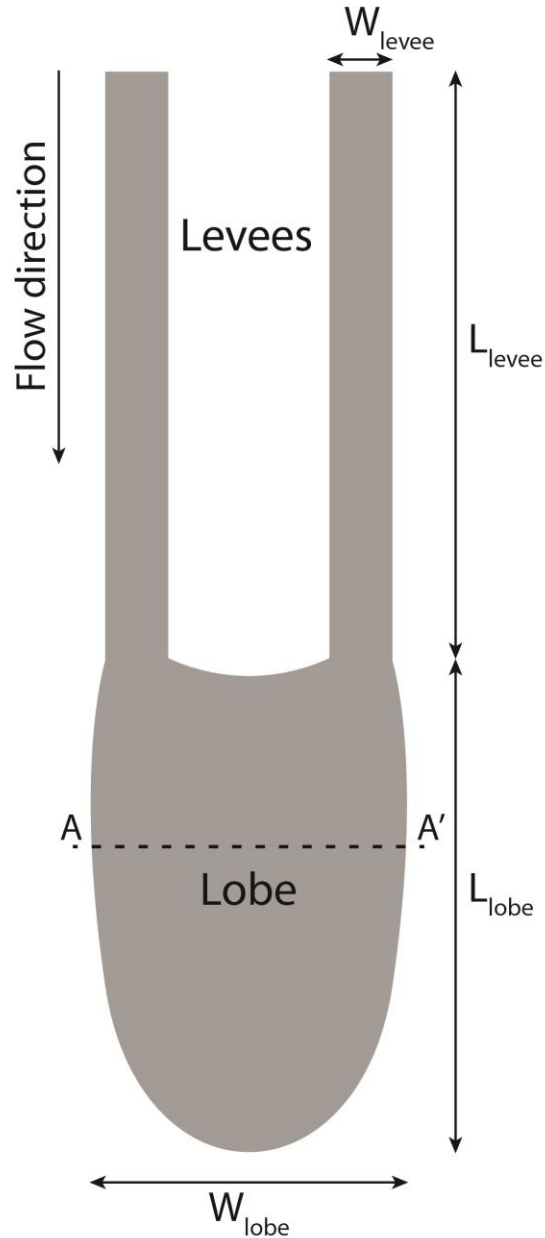
V

Volume & Number of DFs

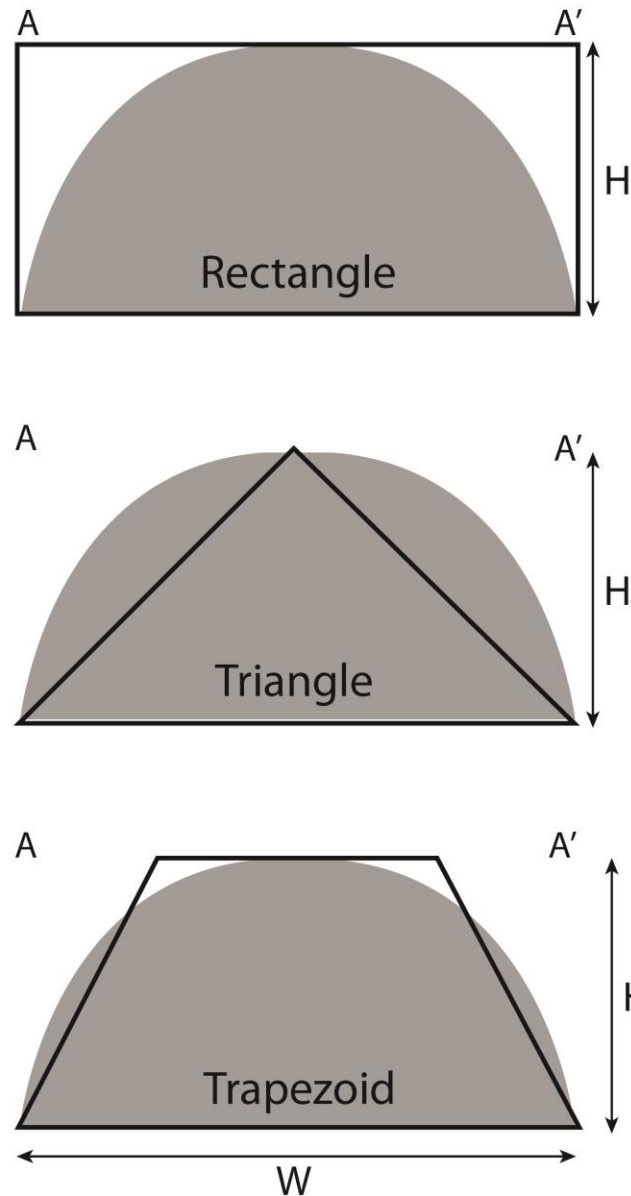
2000 m



## A. Plan view



## B. Cross-profile



## C. Volume calculation

$$V_{lobe} = W_{lobe} \cdot L_{lobe} \cdot H$$

$$V_{levee} = 2 \cdot W_{levee} \cdot L_{levee} \cdot H$$

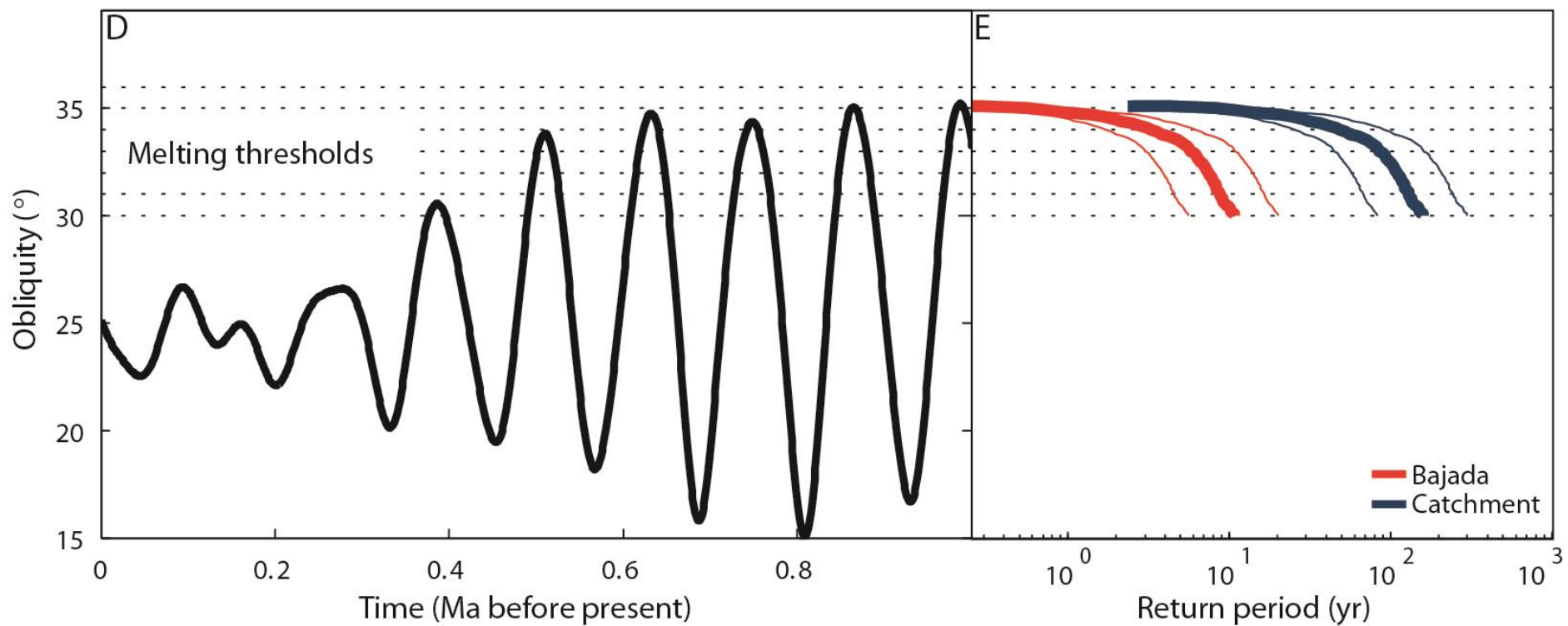
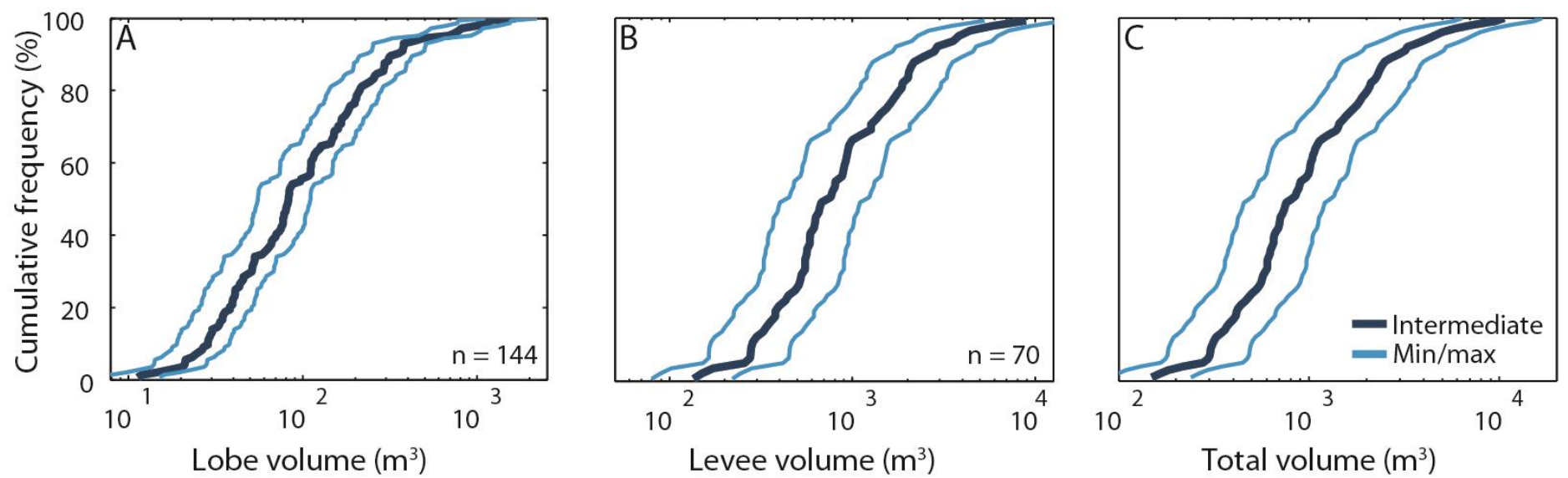
$$V_{lobe} = 0.5 \cdot W_{lobe} \cdot L_{lobe} \cdot H$$

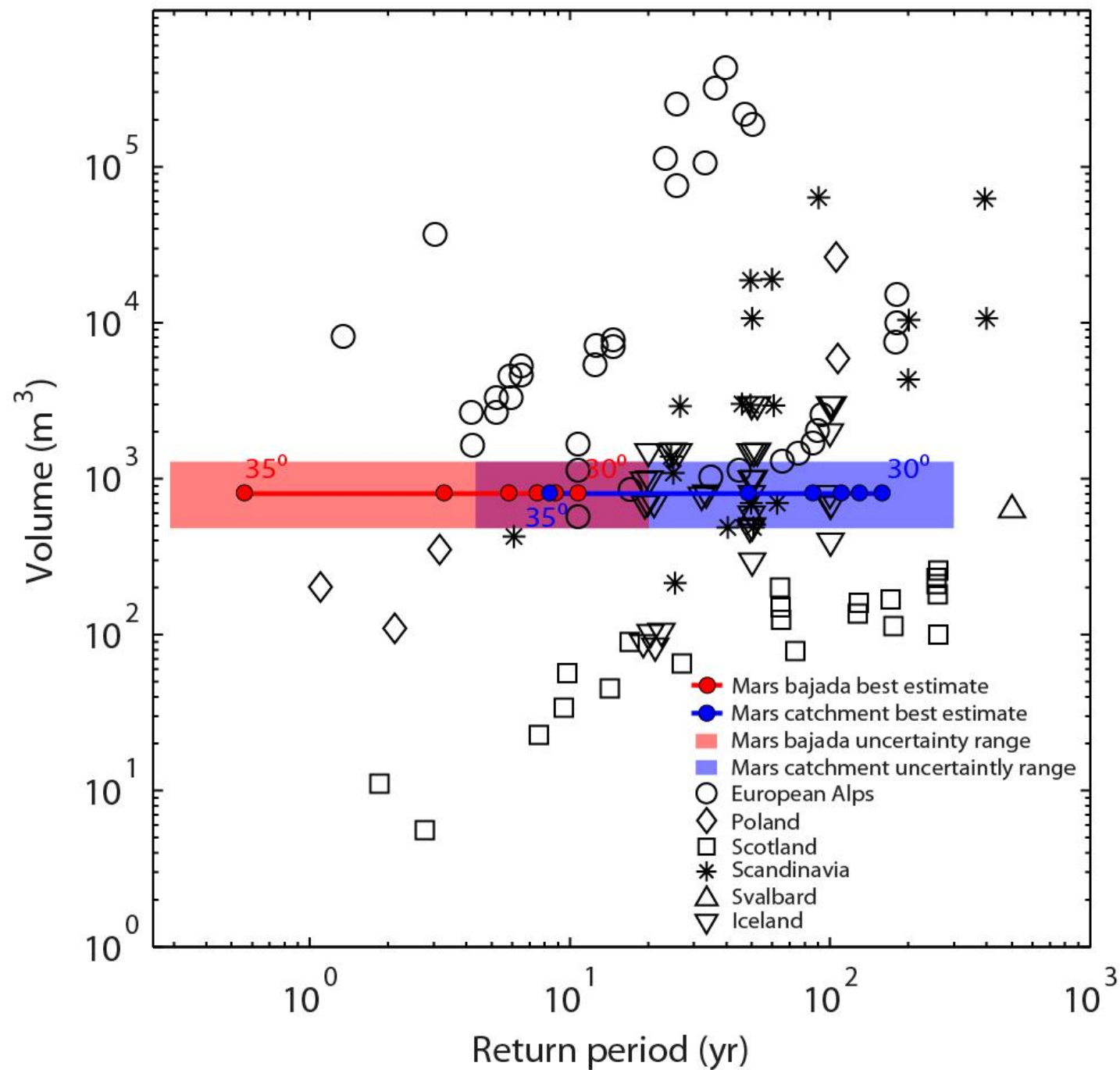
$$V_{levee} = W_{levee} \cdot L_{levee} \cdot H$$

$$V_{lobe} = 0.75 \cdot W_{lobe} \cdot L_{lobe} \cdot H$$

$$V_{levee} = 1.5 \cdot W_{levee} \cdot L_{levee} \cdot H$$







# How much liquid water?

		Water:sediment 0.2		Water:sediment 0.6	
Debris-flow size	Debris-flow volume (m <sup>3</sup> )	Water volume (m <sup>3</sup> )	Water in alcove (mm)	Water volume (m <sup>3</sup> )	Water in alcove (mm)
Modal	802 (482 - 1283)	160 (96 – 257)	4.0 (2.4 – 6.3)	481 (289 – 770)	11.9 (7.2 – 19.0)
95% largest	4538 (2741 – 7186)	908 (548 – 1437)	22.4 (13.6 – 35.5)	2723 (1645 – 4312)	67.3 (40.7 – 106.6)



# Conclusions

- **Earth-like debris-flow frequency and size during high obliquity!**
- **Cm to dm of snow required in alcoves.**
- **Mm to cm of liquid water required in alcoves**

De Haas et al., 2015: Nature Communications